

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
RESEARCH AND TECHNOLOGY RESUME

TITLE

Radar Investigation of Asteroids and Planetary Satellites

PERFORMING ORGANIZATION

Jet Propulsion Laboratory
4800 Oak Grove Drive
Pasadena, CA 91109

INVESTIGATOR'S NAME

Steven J. Ostro

DESCRIPTION (a. Brief statement on strategy of investigation; b. Progress and accomplishments of prior year; c. What will be accomplished this year, as well as how and why; and d. Summary bibliography)

a. Strategy: Radar reconnaissance of near-Earth asteroids, mainbelt asteroids, the Galilean satellites, the Martian satellites, and the largest Saturnian satellites, using the Arecibo 13-cm and the Goldstone 3.5-cm systems. Measurements of echo strength, polarization, and delay/Doppler distribution of echo power provide information about dimensions, spin vector, large-scale topography, cm-to-m-scale morphology, and surface bulk density. The observations also yield refined estimates of target orbital elements.

b. Accomplishments: Radar signatures have been measured for 31 mainbelt asteroids and 16 near-Earth asteroids since this task began eight years ago. The dispersion in asteroid radar albedoes and circular polarization ratios is extreme, revealing huge differences in surface morphologies, bulk densities, and metal concentration. For the most part, correlation between radar signature and VIS/IR class is not high. Many near-Earth asteroids have extremely irregular, nonconvex shapes, but some have polar silhouettes that appear only slightly noncircular. The signatures of 1627 Ivar, 1986 DA, and the ~180-km mainbelt asteroid 216 Kleopatra suggest bifurcated shapes. Observational milestones during 1987-88 include (i) the first definitive measurement of Io's dual-polarization, 13-cm radar signature; (ii) highly successful, initial radar studies of two near-Earth objects: 1981 Midas at 13.5-cm and the rendezvous-mission candidate 3757 (1982 XB) at 13-cm; (iii) the first 3.5-cm radar detection of Callisto; (iv) the first 13-cm radar observations of the icy Galilean satellites since 1979, with several times the SNR available then; and (v) a series of time-delay-resolved observations of the mainbelt asteroid 654 Zelinda with a "range" precision of 10 km.

c. Anticipated Accomplishments: 1) The first radar observations of Phobos and Deimos. 2) Extensive 13-cm and 3.5-cm investigations of all four Galilean satellites during the most favorable Jupiter opposition of the next ten years. 3) High-resolution delay/Doppler imaging of asteroids 1685 Toro, 1580 Betulia, and 1980 PA.

ORIGINAL PAGE IS
OF POOR QUALITY

RADAR INVESTIGATION OF ASTEROIDS AND PLANETARY SATELLITES

196-41-73-06-55

S. J. OSTRO, PI

MAY 1987 - JUNE 1988

Publications:

Ostro, S. J.: Physical Properties of Asteroids from Radar Observations. The Evolution of the Small Bodies in the Solar System (M. Fulchignoni and L. Kresak, eds.), Soc. Italiana di Fisica, Bologna, Italy, 131, 1987.

Yeomans, D. K., Ostro, S. J., and P. W. Chodas, P. W.: Radar Astrometry of Near-Earth Asteroids. *Astron. J.* 94, 189, 1987.

Ostro, S. J. (1987). Benefits of an Upgraded Arecibo Observatory for Radar Observations of Asteroids and Natural Satellites. Proceedings of the Arecibo Upgrading Workshop (J. H. Taylor and M. M. Davis, eds.), National Astronomy and Ionosphere Center, Box 995, Arecibo, PR 00613; 233, 1987.

Ostro, S. J., Connelly, R., and Belkora, L.: Asteroid Shapes from Radar Echo Spectra: A New Theoretical Approach. *Icarus* 73, 24, 1988.

Ostro, S. J.: Radar Observations of Asteroids. Chapter in Asteroids II (R. P. Binzel, T. Gehrels, and M. S. Matthews, eds.), Univ. of Arizona Press, accepted, 1988.

Ostro, S. J., Yeomans, D. K., Chodas, P. W., Goldstein, R. M., Jurgens, R. F., and Thompson, T. W.: Radar Observations of Asteroid 1986 JK. Submitted to *Icarus*, 1988.